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Original Article

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What is the benefit of venous mapping in saphenous vein harvesting?

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ABSTRACT

Objectives: This study aimed to demonstrate that the use of the vein mapping technique before coronary artery bypass surgeries can reduce postoperative complications.

Patients and methods: A total of 245 patients (181 males, 64 females; mean age: 64.6±9.4 years; range, 43 to 85 years) who underwent coronary artery bypass grafting surgery in the Department of Cardiovascular Surgery of Başkent University Ankara Hospital between April 2019 and September 2020 were enrolled in this study. Patients with early postoperative mortality (first month), deep vein thrombosis, or a history of lymphedema, patients undergoing emergent surgery, and reoperation cases were excluded from the study. Patients were divided into two groups: 109 patients (mean age: 64.5±8.9 years) who were treated by the conventional method (CM group) and 136 patients (mean age: 64.7±9.5 years) who were treated with the venous mapping technique (VM group). Of the patients in the VM group, 46 (mean age: 65.0±9.2 years) were treated using LigaSure (VML group), and 93 (mean age: 64.6±9.7 years) were not treated with LigaSure (IVM group). The patients were followed up for three months for the development of ecchymosis, hematoma, and superficial and deep tissue infections.

Results: There was no statistical difference between the groups in terms of sex (p=0.953). There was no statistical difference between the four groups in terms of risk factors for infection determined in the literature. Incision line complications developed in 42 (38.53%) patients in the CM group, 30 (22.05%) in the VM group, 22 (23.65%) in the IVM group, and eight (18.6%) patients in the VML group. While all groups were statistically superior to the CM group in terms of complications, no significant difference was found between the IVM and VML groups in terms of these complications.

Conclusion: Vein mapping technique performed with Doppler ultrasonography in the operating room is a fast, reliable, easily accessible, and low-cost procedure, allowing a significant reduction in the complication rates associated with the saphenous vein incision line. Therefore, we think that the vein mapping method should be used routinely, particularly in the group of patients who have risk factors for incision line complications.

Keywords: Great saphenous vein harvesting, saphenous vein harvesting complications, venous mapping.

Coronary artery bypass grafting (CABG), performed since 1968, is one of the most common operations in cardiac surgery.[1] Although arterial grafts have longer patency, saphenous vein grafts are still frequently used, particularly in multivessel bypasses.[1-3] Following a single continuous incision or skipping incisions, the saphenous vein is harvested via direct vision. Postoperative complications such as ecchymosis, hematoma, tissue necrosis, and infection may develop in the harvesting area. In these situations, patients are usually followed up as outpatients with oral antibiotic therapy; however, hospitalization is needed in cases requiring intravenous antibiotic therapy or surgical debridement.

As a result, there is an increase in hospitalization periods, the need for antibiotic use, and ultimately, in health expenditures. Studies have shown that complications due to saphenous vein harvesting vary between 3 and 48%.[1,4,5] The infection rate at the saphenous incision site after CABG is

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between 4 and 18%.[6] According to the data of the Society of Thoracic Surgeons (STS), hospitalizations due to complications of saphenous harvesting site accounted for 4.5% of hospitalizations related to complications after CABG in 1999.[7-9]

Vein mapping is a technique used to determine the anatomy, course, and quality of the saphenous veins of the patients with ultrasonography before surgery. It is noninvasive, cheap, and applied in the operating room or ward bed. Evaluating whether the saphenous vein is thrombosed, sclerotic, aneurysmatic, or has an inappropriate calibration helps physicians to choose the best graft for the patient.[8] Shortening of the incision length, reduction in the duration of harvesting, and rate of postoperative incisional complications can be achieved due to this technique.[8,10]

This study aimed to demonstrate that the venous mapping technique is more advantageous in terms of postoperative complications by comparing the patients in whom we applied the venous mapping technique with those we operated on with the conventional method.

PATIENTS AND METHODS

The venous mapping study included 245 patients (181 males, 64 females; mean age: 64.6±9.4 years; range, 43 to 85 years) who underwent CABG surgery in the Department of Cardiovascular Surgery of Başkent University Ankara Hospital between April 2019 and September 2020. Patients with early postoperative mortality (first month), deep vein thrombosis, or a history of lymphedema, patients undergoing emergent surgery, and reoperation cases were excluded from the study. Patients were divided into two groups: 109 patients (mean age: 64.5±8.9 years) who were treated by the conventional method (CM group) and 136 patients (mean age: 64.7±9.5 years) who were treated with the venous mapping technique (VM group). Of the patients in the VM group, 46 (mean age: 65.0±9.2 years) were treated using LigaSure (VML group), and 93 (mean age: 64.6±9.7 years) were not treated with LigaSure (IVM group).

The patients were followed up for three months for the development of ecchymosis, hematoma, and superficial and deep tissue infections. Ecchymoses detected by inspection, palpable hematomas in the subcutaneous tissue diagnosed in ultrasonographic evaluation, skin rash, local temperature increases, superficial skin infections requiring antibiotic use with or without dehiscence in the incision, and deep-tissue infections requiring surgical debridement were considered as significant complications. Surgical techniques that were utilized are described in the following paragraphs.

Conventional method

The saphenous vein was harvested 1 cm above the medial malleolus of the ankle. After a 5 to 6 cm incision, a 3 to 4 cm tunnel was created, and a second 5 to 6 cm incision was performed, which was continued until the knee level. If necessary, the same procedure was applied to the other leg. Skin incisions were made with a scalpel, and the subcutaneous tissue was dissected with a scissor. No flap was removed in any of the patients. The lateral branches were tied with a 4/0 silk suture, and the distal portion of the side branches was clipped.

Vein mapping technique

Vein mapping was performed with Doppler ultrasound after anesthesia induction in the operating room. Saphenous vein calibration, sclerosis, and thrombosis were evaluated. If the measured saphenous vein diameter was below 2 mm or above 6 mm, that part of the vein was not used. The locations of saphenous vein branches were marked preoperatively. Afterward, incisions were made in the areas where the branches were located. Tunnels were created as extended as possible between these incisions. As in the conventional method, branches of the saphenous vein were tied with 4-0 silk, the distal parts were clipped, and the saphenous vein harvesting was started at the ankle level.

No-touch vein mapping technique

Vein mapping was performed as described in the previous paragraph. Incisions were made as in the standard vein mapping technique. After the skin was incised, the subcutaneous tissue was dissected with LigaSure (Covidien Japan Inc., Tokyo, Japan), and the saphenous vein was removed with the surrounding tissue using the no-touch technique.

Skin closure and wound care

Bleeding control was provided in all patient groups with a hemoclip and electrocautery. In all patients, subcutaneous tissue was closed continuously with 2-0 Vicryl suture (polyglactin 910; Ethicon Inc., Somerville, NJ, USA), and skin was closed subcutaneously with 4/0 Vicryl suture. After a sterile wound dressing, an elastic bandage was applied to all patients. Antibiotic prophylaxis was performed with

cefazolin sodium routinely. Wound dressings were opened on the postoperative first day, and hematoma control was performed. The elastic bandage application was continued in the presence of a hematoma. In addition, all patients were put on antiembolic stockings in sizes varying according to the leg diameter from the first postoperative day until discharge, and the patients were switched to compression stockings under the knee with a pressure of 18-21 mmHg at the time of discharge.

Statistical analysis

Statistical analysis was performed with IBM SPSS version 25.0 software (IBM Corp., Armonk, NY, USA). Pearson chi-square test was used in the comparison of categorical data. Mann-Whitney and Fisher-Freeman-Halton exact tests were used when necessary, depending on the assumptions, and the places used were also specified, the interpretation does not change. A *p* value of >0.05 was considered statistically significant.

RESULTS

There was no statistical difference between the groups in terms of sex (p=0.953) or age (p=0.965). Body mass indexes (BMIs) of 49 patients in the CM group, 57 in the VM group, 38 in the IVM group, and 19 in the VML group were below 25. The number of pre-obese patients (BMI 25-29.9) was 31 in the CM group, 43 in the VM group, 30 in the IVM group, and 13 in the VML group. The number of obese patients (BMI ≥30) was 29 in the CM group, 36 in the VM group, 25 in the IVM group, and 11 in the VML group. The mean BMI was 28.3±4.5 in the CM group, 28.0±4.6 in the VM group, 28.0±4.9 in the IVM group, and 28.2±4.1 in the VML group. There was no statistically significant difference in the BMI between the groups (p=0.867; Table 1). There was no statistical difference between the four groups in terms of risk factors for infection determined in the literature. Incision line complications developed in 42 (38.5%) patients in the CM group, 30 (22.1%) in the VM group, 22 (23.7%) in the IVM group, and eight (18.6%) patients in the VML group. The remaining three groups were statistically superior to the CM group in terms of complications (VM *vs.* CM, IVM *vs.* CM, VML *vs.* CM; p=0.005, p=0.005, p=0.024, respectively). No significant difference was found between the IVM and VML groups in terms of these complications (p=0.630).

In the early postoperative period, ecchymosis occurred in 23 (21.1%) patients in the CM group, 22 (16.2%) in the VM group, 16 (17.2%) in the IVM group, and six (14%) in the VML group, with no significant difference between the groups (p=0.553). Hematoma developed in the postoperative period in 11 (10.1%) patients in the CM group, eight (5.9%) in the VM group, six (2.5%) in the IVM group, and two (4.7%) patients in the VML group, with no significant difference between the groups

Table 1. Clinical and demographic parameters among the subgroups

	CM		VM		IVM		VML		
	n	%	n	%	n	%	n	%	*p*
Number of patients	109		136		93		43		
Sex									0.953
Male	80	73.4	99	72.8	67	72	32	74.4	
Female	29	26.6	37	27.2	26	28	11	25.6	
Smoking	38	34.9	44	32.4	29	31.2	15	34.9	0.839
Hyperlipidemia	64	58.7	78	57.4	53	57	25	58.1	0.969
Diabetes mellitus	57	52.3	71	52.2	49	52.7	22	51.2	0.986
COPD	16	14.7	22	16.2	15	16.1	7	16.3	0.949
CRF	11	10.1	14	10.3	9	9.7	5	11.6	0.940
Heart failure	14	12.8	18	13.3	12	12.9	6	14	0.982
Hypothyroidism	8	7.3	11	8.1	8	8.6	3	7	0.925
IABP use	5	4.6	8	5.9	4	4.3	4	9.3	0.382
PVD	32	29.5	40	29.4	28	30.1	12	27.9	0.966

CM: Conventional method; VM: Venous mapping; IVM: Venous mapping subgroup harvesting without LigaSure; VML: Venous mapping subgroup harvesting with LigaSure; COPD: Chronic obstructive pulmonary disease; CRF: Chronic renal failure; IABP: Intraaortic baloon pump; PVD: Periferik vascular disease.

(p=0.442). There were 20 (18.3%) patients with wound infection in the CM group, 18 (13.2%) patients in the VM group, 14 (15.1%) patients in the IVM group, and four (9.3%) patients in the VML group, with no statistically significant difference between the groups (p>0.05). Superficial wound infection occurred in 17 (15.6%) patients in the CM group, 15 (11.1%) patients in the VM group, 11 (11.8%) patients in the IVM group, and four (9.3%) patients in the VML group, with no significant difference between the groups (p=0.528). Wound infection requiring deep debridement or intervention in the postoperative period occurred in five (4.6%) patients in the CM group, four (2.9%) in the VM group, three (3.2%) in the IVM group, and one (2.3%) in the VML group, with no statistically significant difference between the groups (p=0.908).

DISCUSSION

The length of the incisions made during conventional saphenous vein harvesting in CABG surgery, together with some risk factors of the patient, causes wound complications in the postoperative period, which increases the risk for significant comorbidity in the patients and leads to an increase in hospitalizations and health care expenses. Therefore, new techniques are used for the preparation of saphenous vein grafts with the contribution of technological developments. The main goal of this attempt is to reduce postoperative complications, shorten the duration of hospitalization, increase patient satisfaction, and reduce health expenditures. According to studies, risk factors for incision site complications can be listed as follows: age, sex, a BMI greater than 30, a low left ventricular ejection fraction corresponding to heart failure (<35%), diabetes mellitus, chronic obstructive pulmonary disease, chronic renal failure or renal dysfunction, peripheral artery disease, intra-aortic balloon use, hyperlipidemia, hypothyroidism, flap removal, lymphedema, deep vein thrombosis, and tobacco use.[2,11,12]

It has been shown that the incidence of complications associated with the incision line is between 3 and 43.8%.[1-5] DeLaria et al.[5] demonstrated that hospitalizations due to the saphenous vein harvesting incision line complications developing in the postoperative period cause a significant increase in health expenditures. In a study by Yun et al.,[13] saphenous vein harvesting via conventional long incision significantly increased postoperative complications. They also defined cellulitis, lymphangitis, drainage, edema, pain, hematoma, skin necrosis, and infection as common complications. It was stated that health expenses, hospital stay, and patient dissatisfaction increased due to these complications.[13] Luckraz et al.[10] demonstrated the benefits of revealing the anatomy and course of the saphenous vein in the preoperative period using the venous mapping technique with Doppler ultrasonography, which decreased the risk of flap removal during harvesting and postoperative hematoma development. In a considerable number of studies in the literature, preoperative venous mapping technique has been utilized to determine the branching locations, possible duplications, the presence of venous insufficiency, and saphenous vein quality before surgery, allowing the size of the planned incisions to be made accordingly, increasing patient satisfaction and comfort, and decreasing in-hospital stay and complications.[5,10,11,14]

Cohn and Korver[15] stated that performing Doppler ultrasonography under operating room conditions is a fast, easy, cheap, and applicable method for using an ideal saphenous vein as a graft. In addition, it was mentioned that this method reduces surgical dissection, incision sizes, loss of time, saphenous vein wastage, and incision complications. Belczak et al.[16] stated that the rate of complications associated with saphenous vein incision line was 31% in patients operated on with a conventional method, while this rate decreased to 25% in the group with intermittent incision without venous mapping. Furthermore, in the study conducted by Gelape,[17] while the risk of developing complications was 30% with conventional incision, this risk decreased to 12% with the venous mapping technique. In our study, while the rate of incision-related complications was 38.5% in the CM group, it was 22.05% in patients for whom we preferred the venous mapping technique. In the subgroups of patients who underwent venous mapping, this rate was 23.65% in the VM group and 18.6% in the VML group.

There was a statistically significant difference between the CM group and the VM group in terms of complication development (p<0.005). Although there is no statistically significant difference between the IVM and VML groups, we think that a significant difference can be demonstrated in studies conducted in larger patient groups.

Studies have revealed that the saphenous vein preparation duration is significantly shortened in

patients who underwent venous mapping techniques during the perioperative period.[10,15,18] In our practice, the duration of saphenous vein harvesting was significantly shortened, particularly after the use of LigaSure, and bleeding control was faster and easier.

The main limitation of the study is that it is a retrospective, single-center study with a small sample size.

In conclusion, the venous mapping technique to be performed with Doppler ultrasonography in the operating room is a fast, reliable, easily accessible, and low-cost procedure. It is possible to achieve a significant reduction in the complication rates associated with the saphenous vein incision line owing to this technique. We believe that the venous mapping method should be routinely used, particularly in patients who have risk factors for incision line complications.

Ethics Committee Approval: A written informed consent was obtained from all participants. The study protocol was approved by the Başkent University Ethics Committee (KA20/373). The study was conducted following the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from all participants

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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